Wisconsin's Great Lakes Beach Monitoring & Notification Program

Annual Report
Beach Season 2008

Bureau of Watershed Management
Wisconsin Department of Natural Resources

Acknowledgements

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Local participants include:

Ashland County Health Department
Bayfield County Health Department
Brown County Health Department
City of Milwaukee Health Department
Door County Health Department
Douglas County Health Department
Iron County Health Department
Kenosha County Division of Health
Kewaunee County Health Department
Manitowoc County Health Department
North Shore Health Department
Ozaukee County Health Department
City of Racine Health Department
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Shorewood/Whitefish Bay Health Department
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A BEACH Act Workgroup was formed during the infancy of this program in Wisconsin to help develop Wisconsin's Great Lakes Beach Monitoring & Notification Program. Cooperators involved with this effort included:

Keep Our Beaches Open
City of Racine Health Department
Kenosha County Health Department
City of Madison Public Health Department
Ozaukee County Health Department
City of Milwaukee Health Department
Wisconsin State Lab of Hygiene
Milwaukee Metropolitan Sewerage District
Wisconsin Department of Health & Family Services
University of Wisconsin - Milwaukee WATER Institute

Thank you to everyone who makes Wisconsin's Great Lakes Beach Monitoring & Notification Program a success!

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Cover Photo: Saxon Harbor Beach on Lake Superior (Iron County), Courtesy Dr. Greg Kleinheinz

Summary

The summer of 2008 marked the sixth season of Wisconsin's Great Lakes Beach Monitoring & Notification Program. Working with a grant of $222,420 from the United States Environmental Protection Agency (US EPA) to implement the program, 123 monitoring sites at public beaches along Lake Superior and Lake Michigan were sampled for *Escherichia coli* (*E. coli*) bacteria. The funding for this program was authorized as part of the federal Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000.

The primary goal of Wisconsin's program is to increase visitors' awareness of potential exposure to disease-causing microorganisms in water. *E. coli* is a bacteria species that serves as an indicator organism because it is commonly found in the feces of all warm-blooded animals. When high levels of *E. coli* are detected, it is likely that fecal matter is present in the water which suggests that humans may be exposed to other harmful pathogens like bacteria, viruses, and protozoans. Potential sources of *E. coli* contamination at Wisconsin beaches include agricultural and urban stormwater runoff and sewage overflows. In addition, localized sources from wildlife and waterfowl feces may contribute to high levels of *E. coli* in both beach sand and water.

Sixteen health departments along Lake Michigan and Lake Superior were funded to sample the water at selected public beaches one to five times per week. Along with sampling efforts, beach users are notified of risk through the use of signs when results indicate an exceedance of US EPA recommended *E. coli* levels (Appendix A). Advisories and closures may also follow rainfall events, stormwater and/or sewage overflows, which may increase the *E. coli* concentration in water. Other factors that may influence *E. coli* concentrations include: the presence of *Cladophora* (a green alga that accumulates on the shoreline in large mats causing nuisance conditions for beach users), wind direction, wave height, water temperature, and beach grooming.

Yellow "Advisory" signs are posted at the beaches when the water sample exceeds the *E. coli* daily maximum standard of 235 cfu[1]/100mL. In 2008, about 14% of the samples analyzed exceeded 235 cfu/100mL.

Red "Closed" signs are posted at the beach when the samples exceed a threshold of 1,000 cfu/100mL. Approximately 5% of the samples analyzed resulted in beach closures in 2008. Table 1 summarizes by each county, the annual percentage of "Advisory" postings.

Table 1. Annual sample % exceeding advisory level of 235 cfu/mL

County	2003	2004	2005	2006	2007	5-Year Average	2008
Ashland	3.2%	10.2%	4.6%	3.5%	3.8%	5.1%	3.3%
Bayfield	1.9%	2.2%	4.3%	7.1%	7.1%	4.5%	3.1%
Brown	0.0%	2.0%	1.8%	0.0%	4.5%	1.7%	0.0%
Door	4.1%	8.2%	6.9%	7.3%	4.8%	6.3%	6.3%
Douglas	9.5%	11.8%	23.7%	12.9%	11.3%	13.8%	18.8%
Iron	1.1%	1.5%	2.7%	3.5%	0.0%	1.8%	0.0%
Kenosha	21.0%	36.3%	31.9%	29.9%	32.2%	30.3%	31.7%
Kewaunee	26.0%	33.9%	26.9%	33.9%	49.7%	34.1%	11.1%
Manitowoc	49.6%	40.1%	20.4%	54.4%	31.7%	39.2%	31.3%
Milwaukee	24.3%	38.7%	30.3%	20.0%	23.7%	27.4%	22.4%
Ozaukee	15.9%	28.9%	12.9%	17.1%	27.6%	20.5%	24%
Racine	16.5%	17.6%	7.4%	6.9%	6.7%	11.0%	6.7%
Sheboygan	23.8%	30.2%	24.8%	43.9%	28.5%	30.2%	18.1%
State-wide	14.6%	22.2%	15.7%	17.5%	17.1%	17.4%	14.4%

[1] cfu = Colony Forming Units: A unit of measurement used in microbiology that indicates the number of viable microorganisms present in a water sample.

Introduction

The BEACH Act of October 2000 requires states that border coastal or Great Lakes waters to develop beach monitoring and public notification programs. Under the BEACH Act, the US EPA provides grants to states to develop and implement these programs. In 2008, the WDNR, working closely with local health departments and university researchers, conducted the sixth summer of the statewide beach-monitoring and notification program on the shorelines of Lake Michigan and Lake Superior. These activities were conducted during Federal Fiscal Year 2008 (October 1, 2007 through September 30, 2008).

Program Overview

This program began in 2002 when a workgroup was formed of state-level environmental and public health officials, local health officials, and other interested parties to design a beach monitoring and notification program (see Acknowledgements). Approximately 55 miles of public beach miles at 192 coastal beaches were identified along Lake Michigan and Lake Superior (Appendices B & C). The definition of "beach" for the purpose of the Wisconsin Great Lakes Beach Monitoring & Notification Program implementation is:

> *"A publicly owned shoreline or land area, not contained in a man-made structure, located on the shore of Lake Michigan or Lake Superior, that is used for swimming, recreational bathing or other water contact recreational activity."*

Coastal beaches were geo-located using geographic positioning software (GPS) and geographic information system (GIS) technologies and maps were created for each county identifying the locations of beaches. Information was collected on the potential for impacts to each beach such as: stormwater outfalls, human and waterfowl usage, proximity of wastewater treatment plant outfalls and farms. This information was used to rank and classify beaches as "high," "medium," or "low" priority in order to distribute funds equitably while recognizing relative levels of pathogen exposure.

A standard sampling protocol was developed and standard advisory signs were designed based on feedback collected during a beach user survey in 2002 and public meetings held around the state (Appendix D). Currently, the WDNR contracts with the United States Geological Survey (USGS) to oversee data management and the Wisconsin Beach Health Website (http://www.wibeaches.us). This website provides the public with general information about the Beach Program and the most up-to-date beach health conditions.

Goals & Objectives

The purpose of this project in 2008 was to maintain a consistent statewide Great Lakes beach water monitoring program to improve public notification and to reduce beach visitors' risk of exposure to disease-causing microorganisms in water. Selected beaches along Lake Michigan and Lake Superior were monitored in accordance with BEACH Act requirements with prompt notification to the public whenever bacterial levels exceeded the US EPA's established standards (Appendix A). Due to restrictions on how grant funds can be used, identification and control of pollution sources leading to elevated bacteria levels has not been a routine element of Wisconsin's program to date.

Time Schedule

The activities described in this report took place during Federal Fiscal Year (FFY) 2008 (October 1, 2007 through September 30, 2008). FFY 2008 encompassed the entire 2008 beach season, which is defined for Wisconsin coastal beaches as Memorial Day Weekend through Labor Day Weekend, which was approximately 15 weeks for the 2008 beach season. At some coastal beaches in Wisconsin, swimming may not begin until mid-June due to cold water temperatures. Where weather and swimming history

indicate this to be the case, initial sampling associated with this program was reduced or delayed to coincide with the local swimming season in order to save funds until the beach was used more frequently. This report describes activities conducted before, during, and after the 2008 beach season (i.e. preparation, implementation and evaluation of the beach season).

Budget

Following the 2007 Beach Season, Wisconsin was awarded an additional $44,000 by the US EPA to supplement administration of the program and enhance public education of the program. Materials promoting the Beach Health Website were produced (i.e., magnets, brochures, and signs). Some of the supplemental funding was intended to be used to cover the costs of a Public Beach Summit meeting, but interest was low and this funding was re-directed to create a DVD for wide distribution on how to perform Beach Sanitary Surveys. The completed DVD will be available in the Spring of 2009 with distribution expected in time for the 2009 Beach Season.

In May of 2008, the WDNR was awarded a grant in the amount of $222,420. However, this funding was insufficient to fully implement the program. In order to monitor Great Lakes beaches with at least the same frequency as the previous season, some of the remaining FFY07 funds were used to supplement anticipated costs for data management. In 2008, 82% of the base grant was used to fund the local health department efforts to sample the beaches (Table 2). The remaining funds covered data management costs with the United States Geological Survey and administrative costs within WDNR.

Work Completed in 2008

The 2008 beach season was the sixth year of implementing the Wisconsin Great Lakes Beach Monitoring & Notification Program. Work completed in 2008 included:

Table 2. Participant Contract Allocations in 2008.

County	Allocation
Ashland, Bayfield & Iron Counties (Group Contract)	$30,725
Brown County	$2,000
Door County	$50,725
Douglas County	$9,125
Kenosha County	$9,325
Kewaunee County	$5,725
Manitowoc County	$8,190
Milwaukee, City of	$20,070
Northshore, Village of	$2,725
Ozaukee County	$16,725
Racine, City of	$6,600
Sheboygan County	$12,725
Shorewood, Village of	$3,535
South Milwaukee, City of	$5,275
Total:	$183,470.00

- Contracted with 16 individual health departments in 13 counties to conduct the routine monitoring of 123 beaches along Lake Superior and Lake Michigan.
- Evaluating and redistributing allocations to each of the contracting entities based on the number of high, medium, or low priority beaches, a minimum sample per beach (plus 15% for re-sampling after advisories or closures). Note: Adjustments were made for travel reimbursement related to sampling due to high gas prices.
- Development of secure on-line input forms to update information about beaches, monitoring stations, and personnel utilizing the Wisconsin Beach Health Website (http://www.wibeaches.us). Data entry protocols continue to be redesigned to be more efficient for the local health departments. A comma-separated value (*.csv) is used for all reports downloaded from the website.
- An automatic e-mail messaging service and a really simple syndication service (RSS Feed) provided daily updates on beach conditions to the public.

- The USGS created data entry tools for beach managers to enter beach sanitary survey information about each beach as well as the standard *E. coli* monitoring data. In 2008, beaches in Ashland, Bayfield, Brown, Door, Douglas, Kenosha, Milwaukee, Ozaukee, Racine, and Sheboygan counties entered a variety of data including:

  - Algae
  - Animal Use Counts
  - Beach User Activities
  - Clarity & Color
  - Current (Speed & Direction)
  - Debris (Presence)
  - Human Use Count
  - pH
  - Precipitation
  - Temperature (Air & Water)
  - Wave Conditions
  - Wind Conditions

- The WDNR, Wisconsin Department of Health and Family Services (WI DHFS), and the State Laboratory of Hygiene continued their statewide program of inland beach monitoring[2]. Popular swimming beaches at state parks and forests were monitored. The beaches were tested at least 4 times each week with results posted on the beach. The inland program is modeled after the Wisconsin Great Lakes Beach Monitoring & Notification Program on the Great Lakes.

Monitoring Results

A total of 123 monitoring sites were sampled in 2008. More than 4,366 monitoring samples were reported on the Beach Health Website in 2008. Of these samples, 628 (14.4%) exceeded the water quality advisory limit of 235 cfu/100mL and 236 samples (5.4%) exceeded 1,000 cfu/100mL resulting in mandatory beach closures.

Program wide, there were 3.0% fewer advisories in 2008 than the average of the previous five beach seasons (Table 2). Furthermore, compared to both the 2006 and 2007 Beach Seasons, a reduced number of advisories were needed in Ashland, Bayfield, Brown, Door, Iron, Kewaunee, Manitowoc, Racine, and Sheboygan Counties. Trends in bacterial densities are hard to establish and affected by many factors, including sampling frequency, climate, nearby land use, etc. That being said, it appears that some communities and/or counties are having success in increasing awareness of beach health issues and triggering grass roots actions to address some of the core issues. Historical data (2003-2008) may be downloaded from the Wisconsin Beach Health Website (http://www.wibeaches.us).

Current Research and Local Successes

The Wisconsin Great Lakes Beach Monitoring & Notification Program continues to work to increase public awareness about the fecal contamination problems that face the Great Lakes. Several lake shore communities have begun to look at source tracking, identification, and mitigation. Some new ideas and projects from 2008 are highlighted below.

<u>Ashland, Bayfield, and Iron Counties</u>

Ashland, Bayfield and Iron Counties have 200 miles of Lake Superior shoreline that are important tourist destinations. Within these counties, 27 public beaches are monitored at least once per week during the normal beach season for that area (normally mid-June through mid-September). Even though the funding provided by the BEACH Act is a great asset for these northern counties, the BEACH Act funding has been inadequate for a comprehensive monitoring program and other funding sources have been necessary. The local health departments, Northland College, University of WI-Oshkosh, and the Lake Superior Alliance have been brought together to create a comprehensive monitoring and source-tracking program.

[2] This program is supplemental to the Wisconsin Great Lakes Beach Monitoring & Notification program. No BEACH Act funds are used to fund collection of samples from inland beaches.

In response to suspected fecal sources, Bayfield County officials have decided to open a special goose hunt at Thompson West End Park in Washburn to control the high goose population. It is believed that these goose populations are related to the large number of advisories and closures at this beach.

Door County

Door County is one of the most popular summer tourist destinations in Wisconsin. Clean water for recreation is critical to the economy of this area – especially since the beach season coincides with the heaviest tourist activity. In addition to BEACH Act funding, monitoring efforts have continued with the financial support of the Door County Public Health Department, the Door County Soil & Water Conservation Department (DCSWCD), and the University of Wisconsin – Oshkosh. Genetic finger printing and antibiotic resistance testing on *E. coli* isolates, rain event and storm water system samples, bird surveys, and spatial distribution surveys of *E. coli* at the beaches have been used to identify possible contamination sources.

Efforts to mitigate sources continue to be implemented in Door County including: changing impervious surfaces around beaches to porous pavement, as well as construction of rain gardens, naturalized dunes, and bio-filters to remove microbes from storm water. Monitoring efforts continued at these beaches to assess the effects of these management practices.

Douglas County

The City of Superior conducted its annual spring and fall clean-up of Wisconsin Point Beach and the Friends of Brule River conducted an annual spring clean-up of the Brule River State Forest Beach. Douglas County Health department also takes an active role in notifying its citizens of beach health by issuing a press release summarizing the monitoring completed during the beach season.

Milwaukee County

In addition to the projects mentioned above, Dr. Sandra McLellan, with the Great Lakes Water Institute (GLWI), continues to be involved in source and transport mechanisms of *E.coli* at Lake Michigan beaches. One project, funded by Wisconsin Sea Grant, focuses on two main items: 1) determining the source of elevated *E.coli* concentrations in surface water where obvious contamination sources (stormwater or sewage overflows) are absent and 2) characterizing the *E.coli* patterns in the near shore waters of Door and Milwaukee counties. Another project the GLWI is working on is installing rain gardens and green roofs in urban areas to look at the benefits of using on-site storm retention systems to reduce the frequency of flooding events and its conveyance of pollutants to nearby surface waters.

Stormwater infiltration beds were installed by the City of Milwaukee to prevent rainwater from running over sand at Bradford Beach. The US EPA funded research of modeling methods and *Enterococci* PCR methods at South Shore Beach. The City of South Milwaukee also teams up with the City of Racine to conduct additional sampling to identify sources of non-point pollution at Grant Park Beach. The Friends of Atwater Beach held a fundraiser which included a BBQ, Volleyball games, a band, and a bonfire. The funds raised will go towards matching funding for beach health research. Before the bonfire, volunteers were involved in cleaning the beach and removing *Cladaphora*.

City of Racine

The City of Racine continues to team up with the University of Wisconsin – Oshkosh to examine the association between water quality and algal blooms. The City of Racine also continues to conduct microbial and chemical source tracking on the Root River, determine if ambient DNA exists within aquatic environments and how it may impact rapid bio-detection methods like quantitative polymerase chain reaction (qPCR), and conduct parallel routine monitoring for freshwater bacterial indicators using currently approved methods like qPCR.

The City of Racine also encouraged the addition of dune swales by planting approximately 150 new clusters of dune grass to encourage filtration of non-point source pollution from impervious surfaces at North Beach.

International Coastal Clean-up and Wisconsin Coastal Awareness Month

The beach clean-up was held in conjunction with the International Coastal Cleanup and Wisconsin Coastal Awareness Month. Eighteen coastal communities participated in the program which is designed to determine what types of wastes are entering our coastal waters. The following are some highlights of beach health awareness activities held during the 2008 season.

The City of Racine

On Earth Day (April 26, 2008), a meeting was held at the Volunteer Center of Racine County to assist people who were interested in adopting a beach and helping to plant/transplant dune grass. On September 9, 2008, the City of Racine hosted a beach clean-up at North Beach in conjunction with the International Coastal Clean-up and Wisconsin Coastal Awareness Month. Politicians and other Racine-area professionals hosted the clean-up with the help of fifth grade students from Jane's School. On October 25, 2008, the City of Racine celebrated Make-A-Difference Day by planting dune grass to prevent blowing and drifting of beach sands and reduce non-point source pollution.

Sheboygan

The City of Sheboygan Tourism division teamed up with the Sheboygan River Basin Partnership and the Glacial Lakes Conservancy to hold a volunteer Beach Sweep Clean-up Day on September 26, 2008. Over 40 volunteers gathered to collect trash at five area beaches; Deland Park Beach, North Point Beach, Blue Harbor Beach, General King Beach, and Lakeview Beach.

Sanitary Surveys

Sanitary surveys may provide valuable information about potential pollution sources and help stakeholders remediate the sources to provide cleaner and safer beaches. During the 2008 beach season the following counties collected sanitary survey data which was entered into the statewide database: Ashland, Bayfield, Brown, Door, Douglas, Kenosha, Milwaukee, Ozaukee, Racine, and Sheboygan. Sanitary survey data was collected to contribute to the data collected by the initial sanitary surveys conducted by several health departments on their local beaches in 2007. A WDNR report summarizing the conclusions of the project was released before the 2008 beach season. The results of the sanitary surveys will be used to refine the methods for sanitary survey and also identify potential areas of concern. As beach sanitary survey data continues to be collected, more counties are expected to see the benefits resulting from these surveys.

Program Deficiencies

As the Wisconsin Great Lakes Beach Monitoring & Notification Program continues to grow, there are a few changes in the future that could improve the program:

- *Source Identification and Remediation*. After the sixth year of full implementation of the Wisconsin Great Lakes Beach Monitoring & Notification Program, the biggest public concern is still source identification and reduction. Although more communities are becoming more interested in the source of *E.coli* to their beaches, they are not all implementing actions to identify and/or control the source of contamination.

- *Insufficient Funding for Full Implementation.* As in past years, participating counties were asked to reduce monitoring high priority beaches from five times per week to four times per week. The amount of funding made available is not enough for full implementation of the BEACH Act. Wisconsin

received $222,420 and the amount estimated for the basic needs of the program is approximately $300,000 (this excludes staff to administer the program).

To Be Completed for the 2009 Beach Season

A few, but not all, of the beach health-related activities that align well with Wisconsin's Great Lakes Beach Monitoring & Notification Program include:

- University of Wisconsin – Oshkosh researchers as well as others plan to investigate better predictive models.

- Source identification methods such as sanitary surveys will be considered for implementation in the 2009 beach season if funding is available. Sanitary surveys may be conducted in 2009 based on the results of the 2007-2008 beach season sanitary surveys and the funding received for the implementation of the Wisconsin Great Lakes Beach Monitoring & Notification Program.

- Door County Soil and Water Conservation Department (DCSWCD) obtained a Coastal Zone Management Grant and county and municipal funding to hire an environmental consulting firm to design further storm water remediation efforts for eleven beaches in the county (in nine communities). The consulting firm will implement a number of changes to reduce storm water contamination of beach water, depending on beach location.

Conclusion

Even in spite of a limited budget and an uncertain future for the federal BEACH Act, Wisconsin's Great Lakes Beach Monitoring & Notification Program continues to evolve and provide useful monitoring information for health departments and the public. It is hoped that continued support of this program will heighten awareness of beach health and will provide the resources necessary to increase the knowledge of health professionals allowing for more informed decision making by state and local leaders. Further, after six years, it is apparent that the data and experiences gained from this program will continue to aid the public and decision makers in the management of solutions to clean up beaches throughout Wisconsin.

APPENDIX A
Public Notification and Risk Communication Measures

The BEACH Act Workgroup developed a comprehensive communication plan for the 2003 beach season which continues to be implemented. This plan implements the US EPA exceedance standards and beach health advisories.

Exceedance Standards

The US EPA recommends the following exceedance criteria for *E. coli*:

- 235 cfu/100mL as a maximum per sample
- 126 cfu/100mL as a geometric mean for at least 5 samples collected over a 30-day period.

Beach Advisory Posting

High Priority Beaches
Advisory signs (Figure D1) will be posted at high priority beaches under the following conditions:

- whenever the sample results for *E. coli*, *exceeds* 235 cfu/100mL as a single sample maximum
- and/or whenever the sample results for *E. coli*, *exceeds* 126 cfu/100mL as a geometric mean of at least 5 samples collected over a 30-day period.

Figure D1. Yellow "Caution Advisory" Sign

Medium Priority Beaches
Advisory signs (Figure D1) will be posted at medium priority beaches whenever the level of *E. coli* in the beach water sample exceeds 235 cfu/100mL.

Low Priority Beaches
Monitoring at low priority beaches and the posting of signs will be determined on a case-by-case basis. Advisory signs (Figure D1) will be posted at low priority beaches which require weekly monitoring whenever the level of *E. coli* in the beach water sample exceeds 235 cfu/100mL.

Removing Advisory Signs
Beach advisory signs may be removed after the next daily sample is below 235 cfu/100mL *E. coli*.

Beach Closures

Closure signs (Figure D2) will be posted whenever the level of *E. coli* in the beach water sample exceeds 1,000 cfu/100mL.

All beaches will be closed under the following conditions:

- Whenever a human health hazard exists as determined by the local health department (i.e. reported illnesses).
- After a major pollution event where potential exists that indicator levels may be expected to exceed standard (i.e. sewage leak, spill)
- After a significant rainfall event that is determined to impact a beach area through runoff.

Figure D2. Red "Stop Closed" Sign

Re-opening Beaches

Beach closure signs may be removed after the sample results of two consecutive sampling days are below 1,000 cfu/100mL *E. coli*.

Open Beach Signs

Signs (Figures D3 and D4) indicating that beach water quality is below the exceedance standard of 235 cfu/100mL *E. coli*, will remain posted at beaches as long as none of the conditions for posting advisory or closure signs exist.

Figure D3. Sign Interpretations in Spanish and Hmong

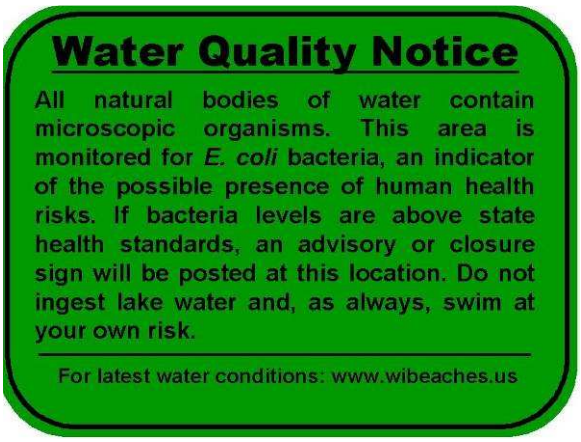


Figure D4. Water Quality Notice Sign

Brochures

An informational brochure was developed by the BEACH Act Workgroup and published by the UW-Extension. This brochure was developed for both Great Lakes and inland beaches. The brochure informs the public of why the waters are being tested and what citizens can do to help keep beaches clean.

Websites

The Wisconsin Beach Health Website (http://www.wibeaches.us) is the primary website for WI Great Lakes beaches and is administered by the US Geological Survey. The Wisconsin Beach Health Website features current and historical monitoring data for both great lakes and inland beaches. There are also tools for the public to receive instant updates, contact information, and program information. The WDNR website (http://dnr.wi.gov/org/water/wm/wqs/beaches/) features information about beach water quality, public health, the BEACH Act, and maps depicting the locations of public beaches along the WI Great Lakes coastlines.

Appendix B
Monitoring Priority of Wisconsin Great Lakes Public Beaches

Ashland County	
Bayview Park Beach	Medium
Big Bay State Park Beach	Low
Big Bay Town Park Beach	Low
Casper Road Beach	Low
Kreher Park Beach	Medium
LaPoint Memorial Beach	Low
Maslowski Beach*	Medium

Bayfield County	
Bark Bay Beach	Low
Bono Creek Beach	Low
Broad Street Beach	Low
Herbster Beach	Low
Highway 13 Wayside Beach	NS
Little Sand Bay Beach	NS
Memorial Beach (Bayfield)	Low
Memorial Park Beach (Washburn)	Low
Port Wing Beach East	Low
Port Wing Beach West	Low
River Loop Road Beach	NS
Sioux River North	Low
Sioux River South	Low
Siskiwit Bay Beach	Low
Thompson West End Park Beach**	Low
Washburn Walking Trail/BAB	Low
Washburn Marina	Low
Washington Avenue Beach	Low
Wikdal Memorial Boat Launch	Low

Brown County	
Bay Beach	NS
Bayshore Park Beach	Low
Communiversity Park Beach	Low
Joliet Beach	NS
Lon Tail Point Beach South	Low
Long Tail Point Beach North	Low
Riverside Drive Beach	NS
Town of Scott Park Beach	NS
Van Lanen Beach	NS
Volks Landing Boat Launch	NS

Door County	
Anclam Park Beach	Medium
Arrowhead Lane Beach	NS
Bailys Harbor Beach	High
Bittersweet Lane Beach	NS
Braunsdorf Beach	NS
Chippewa Drive Beach	NS
Clay Banks Beach #1	NS
Clay Banks Beach #2	NS
Cliff View Drive Beach	NS
County Road TT Beach	NS
Deer Path Lane Beach	NS
Egg Harbor Beach	High
Ellison Bay Town Park Beach	High
Ephraim Beach	High
Europe Bay Beach #1	Medium
Europe Bay Beach #2	Medium
Europe Bay Beach #3	Medium
Fish Creek Beach	High
Garrett Bay Boat Launch	NS
Gislason Beach	Low
Goldenrod Lane Beach	NS
Haines Park Beach	Low
Hemlock Lane Beach	NS
Isle View Beach	NS
Jackson Harbor Ridges Beach	Medium
Kickapoo Drive Beach	NS
Lakeside Drive Beach	NS
Lakeside Park Beach	Medium
Lily Bay Boat Launch	NS
Murphy Park Beach	High
Newport Bay Beach	High
Nicolet Bay Beach	High
Nicolet Boat Launch Beach	Medium
Otumba Park Beach	High
Pebble Beach Road Beach	NS
Percy Johnson Beach	Medium
Portage Park Beach	Medium
Potawatomi State Park #1	NS
Potawatomi State Park #2	NS
Rock Island State Park	Low
Sand Bay Beach #1	NS
Sand Bay Beach #2	NS
Sand Cove Beach	NS

Door County (continued)	
Sand Dune Beach	Medium
Sandy Bay Town Park Beach	Medium
School House Beach	Medium
Sister Bay Beach	High
Sturgeon Bay Canal Rec Area	Medium
Sunset Park Beach (Fish Creek)	NS
Sunset Park Beach (Sturgeon Bay)*	High
White Pine Lane Beach	NS
Whitefish Bay Boat Launch	Low
Whitefish Dunes Beach – WD	High
Whitefish Dunes-Inter Center	High
Winnebago Drive Beach	NS

Douglas County	
Allouez Bay Beach #1	NS
Allouez Bay Beach #2	NS
Allouez Bay Beach #3	Low
Amnicon River Beach**	Low
Barker Island Inner Beach*	Medium
Barker Island Outer Beach	NS
Brule River State Forest Beach #1	Low
Brule River State Forest Beach #2*	Low
Brule River State Forest Beach #3*	Low
Connor's Point Beach	NS
Middle River Beach**	Low
Wisconsin Point Beach #1	Medium
Wisconsin Point Beach #2**	Low
Wisconsin Point Beach #3	Low
Wisconsin Point Beach #4	Low
Wisconsin Point Beach #5	Low

Iron County	
Oronto Bay Beach #1	Low
Oronto Bay Beach #2	Low
Oronto Bay Beach #3	Low
Saxon Harbor Beach East	Low
Saxon Harbor Beach West	Low

Kenosha County	
Alford Park Beach**	Low
Eichelman Beach*	Medium
Lakeshore Drive Beach	NS
Marina/Melissa Beach	NS
Pennoyer Park Beach*	Low
Simmons Island Beach*	Medium
Southport Park Beach**	Low

Kewaunee County	
9th Avenue Wayside Beach	NS
City of Kewaunee Beach *	Low
Crescent Beach*	Medium
Lighthouse Vista Beach	NS
Red River Park Beach	NS

Manitowoc County	
Fischer Park Beach*	Low
Hika Park Beach*	Low
Lincoln High School Beach	NS
Maritime Drive Boat Launch	NS
Memorial Drive Wayside (North)*	Medium
Memorial Drive Wayside (Middle)*	NS
Memorial Drive Wayside (South)*	Medium
Neshota Beach*	Medium
Point Beach (Concessions)*	Medium
Point Beach (Lakeshore)*	Medium
Point Beach (Lighthouse)*	Medium
Red Arrow Park Beach*	Medium
Silver Creek Beach	NS
Two Creek Boat Launch	NS
University Beach	NS
Warm Water Beach	NS
YMCA Beach*	Medium

Marinette County	
Peshtigo Harbor Boat Launch	NS
Michaelis Park Beach	NS
Red Arrow Beach #1	NS
Red Arrow Beach #2	NS
Red Arrow Beach #3	NS
Seagull Bar Wildlife Area	NS

Milwaukee County	
Atwater Park*	Medium
Bayview Park Beach	Low
Bender Park Beach*	Medium
Big Bay Park Beach	NS
Bradford Beach North*	High
Bradford Beach South*	High
Grant Park Beach*	Medium
Klode Park Beach	Medium
McKinley Beach*	Low
Sheridan Park Beach	NS
South Shore Rocky Beach	High

Milwaukee County (continued)	
South Shore Beach*	Low
Tietjen/Doctor's Beach*	Medium
Watercraft Beach	Low

Oconto County	
Oconto City Park Beach	NS

Ozaukee County	
Cedar Road Beach*	High
Concordia Beach	Low
County Road D Boat Launch*	High
Harrington State Park North Beach	High
Harrington State Park South Beach*	High
Jay Road Beach	NS
Lion's Den Gorge North Beach**	Low
Lion's Den Gorge North Beach**	Low
Upper Lake Park North Beach*	High
Upper Lake Park South Beach*	High

Racine County	
Michigan Blvd. Beach	NS
Myers Park Beach	NS
North Beach #1	High
North Beach #2	High
North Beach #3	High
North Beach #4	High
Parkway Beach	NS
Shoop Park Beach	NS
Wind Point Lighthouse Beach	NS
Zoo Beach #1	High
Zoo Beach #2	High
Zoo Beach #3	High

Sheboygan County	
3rd Street Beach	NS
Amsterdam Beach**	Low
Blue Harbor Beach	High
Deland Park Beach*	Medium
Forest Road Beach	NS
General King Beach*	Medium
KK Road Beach**	Low
Kohler Andrae Nature Center*	High
Kohler Andrae North Beach*	High
Kohler Andrae North Picnic Area*	High
Kohler Andrae South Picnic Area*	High
Lakeview Park Beach	NS
Van Ess Road Beach**	Low
Vollrath Park Beach	NS
Whitcomb Avenue Beach	NS
Wilson Lima/White Sands Beach	NS

NS = Not Sampled
* Indicates a beach that is on Wisconsin's 303(d) Impaired Waters List based on percentage of exceedances of 235 cfu/100mL.
** Indicates a beach is proposed for listing on Wisconsins's 303(d) Impaired Waters List based on percentage of exceedances of 235 cfu/100mL.

APPENDIX C
Total Beach Length Per County

County	Total # of Beaches	Total # of Sampled Beaches	Total Beach Distance (Miles)	Total Beach Distance (Feet)	Total Beach Distance (Meters)
Ashland	7	7	2	11,832	3,606
Bayfield	19	16	5	27,022	8,236
Brown	9	3	1	7,712	2,351
Door	53	30	7	34,404	10,486
Douglas	16	12	6	30,454	9,282
Iron	5	5	1	7,624	2,324
Kenosha	7	5	3	14,061	4,286
Kewaunee	5	2	1	7,025	2,141
Manitowoc	17	10	8	40,385	12,309
Marinette	6	0	2	9,268	2,825
Milwaukee	13	11	5	27,889	8.501
Oconto	1	0	0	217	66
Ozaukee	12	7	4	18,521	5,645
Racine	7	2	2	10,739	3,273
Sheboygan	16	9	5	25,823	7,871
Total	**192**	**119**	**52**	**272,976**	**83,203**

APPENDIX D
Tiered Monitoring, Sampling and Analysis Plans

Tiered Monitoring Plan

The tiered monitoring plan describes the monitoring requirements for *High*, *Medium* and *Low* priority beaches. It also addresses when basic sampling should be conducted, when additional samples should be collected and where and how to collect samples.

High Priority Beaches

Basic Sampling	***Additional Sampling***	***Where to Sample***	***Depth to Sample***
• Begin sampling at least one week prior to the swimming season • Sample at least ***4 times*** per week during the swimming season	• After heavy rainfall (generally ¼ to ½ inch- depending on local conditions) • After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards	*Depends on characteristics of the beach* • Middle of typical bathing area • For longer beaches, one sample for every 500m of beach	• Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water • Other as you feel is necessary for your beach *(e.g., surface of water, waist depth, sediment)*

Medium Priority Beaches

Basic Sampling	***Additional Sampling***	***Where to Sample***	***Depth to Sample***
• Begin sampling at least one week prior to the swimming season • Sample at least ***2 times*** per week during the swimming season	• After heavy rainfall (generally ¼ to ½ inch- depending on local conditions) • After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards	*Depends on characteristics of your beach* • Middle of typical bathing area • For longer beaches, one sample for every 500m of beach	• Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water

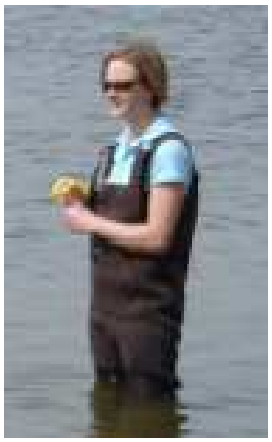
Low Priority Beaches

Basic Sampling	***Additional Sampling***	***Where to Sample***	***Depth to Sample***
• Begin sampling at least one week prior to the swimming season • Sampling frequency at low priority beaches should be determined by state and local authorities, taking into account resource constraints and evaluation of risk factors at individual beaches.	• After a major pollution event where potential exists that indicator levels may be expected to exceed standard (sewage leak, spill) • Immediately following the exceedance of the water quality standards	*Depends on characteristics of your beach* • Middle of typical bathing area	• Knee depth • Where 24-30 inch depth is first encountered, take sample 6-12 inches below surface of water.

Sampling Protocol
The following sampling protocol can also be viewed in a short movie at:
http://slhstream.slh.wisc.edu/mediasite/viewer/

To assure consistency in collecting samples for analysis, the following procedures will be used:
1) Specific sites will be designated for collecting samples during the bathing season. Samples will be collected exclusively at these sites for the duration of the sampling period.
2) Sample bottles will be prepared and provided by the laboratories charged with conducting bacteria analyses.

General Rules of Sampling



- Take extreme care to avoid contaminating the sample and sample container.
- Do not remove bottle covering and closure until just prior to obtaining each sample.
- Do not touch the inside of the sample container.
- Do not rinse the sample container.
- Do not put caps on the ground while sampling.
- Do not transport the samples with other environmental samples.
- Adhering to sample preservation and holding time limits is critical to the production of valid data.
- Samples should be labeled, iced or refrigerated at 1 - 4 degrees C immediately after collection and during transit to the lab.
- Care should be taken to ensure that sample bottles are not totally immersed in water during transit or storage.
- Samples should arrive in the lab no later than 24 hours after collection. Whenever possible samples should arrive at the lab on the day of collection, preferably before 2 p.m.
- The sampler will complete the laboratory data form noting time, date, and location of sample collection, current weather conditions (including wind direction and velocity), water temperature, clarity, wave height and any abnormal water conditions.

Sampling Method
(1) Carefully move to the first sampling location. Water should be approximately knee deep. While wading slowly in the water, try to avoid kicking up bottom sediment at the sampling site.
(2) Open a sampling bottle and grasp it at the base with one hand and plunge the bottle mouth downward into the water to avoid introducing surface scum.
(3) The sampling depth should approximately 6 to 12 inches below the surface of the water.
(4) Position the mouth of the bottle into the current away from your hand. If the water body is static, an artificial current can be created by moving the bottle horizontally with the direction of the bottle pointed away from you.
(5) Tip the bottle slightly upward to allow air to exit and the bottle to fill.
(6) Make sure the bottle is completely filled before removing it from the water.
(7) Remove the bottle from the water body and pour out a small portion to allow an air space of 2 cm for proper mixing of the sample before analyses.
(8) Tightly close the cap and label the bottle.
(9) Store sample in a cooler filled with ice or suitable cold packs immediately.

Analytical Methods
All sample analyses shall be conducted by State certified labs using one of the following US EPA approved methods:

Most probable number (MPN) tests for E. coli:
- LTB EC-MUG (Standard Methods 9221B.1/9221F)
- ONPG-MUG (Standard Methods 9223B, AOAC 991.15, Colilert, Colilert-18, and Autoanalysis Colilert)

Membrane filter tests for E. coli:
- MEndo, LES-Endo, or mFC followed by transfer to NA-MUG media (Standard Methods 9222B/9222G or 9222D/9222G)
- MI Agar, M-ColiBlue24 Broth